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PROCEEDINGS
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BIOLOGICAL SOCIETY OF WASHINGTONA NEW SPECIES OF LARGE *DIPLOGLOSSUS*
(SAURIA: ANGUIDAE) FROM HISPANIOLA

BY ALBERT SCHWARTZ

*Dept. of Biology, Miami-Dade Junior College,
Miami, Florida*

The anguid lizards of the genus *Diploglossus* Wiegmann are widespread on the islands of the Greater Antilles. The number of species on each island, however, varies; Cuba has but a single species (*delasagra* Cocteau), and Puerto Rico likewise has but one galliwasp (*pleii* Duméril and Bibron). Jamaica and Hispaniola have a diversity of forms; the former island has (or had) six species (*occiduus* Shaw, *barbouri* Grant, *crusculus* Garman, *duquesneyi* Grant, *hewardi* Gray, *microblepharis* Underwood) and Hispaniola has five species (*costatus* Cope, *curtissi* Grant, *darlingtoni* Cochran, *sepsoides* Gray, *stenurus* Cope). Another species (*montisserrati* Underwood) is the sole representative of this genus in the Lesser Antilles where it occurs on Montserrat. In addition, *D. costatus* occurs on Navassa (between Hispaniola and Jamaica) and *D. crusculus* occurs on the Lesser Cayman Islands (Little Cayman and Cayman Brac).

Of these species, the least known is *D. occiduus*. Grant (1940:109) was not convinced that *D. occiduus* was extinct, but Cousens (1956:1) stated that this giant galliwasp had not been collected in over 100 years. Although *D. occiduus* had in early times been reported to live in swamps and to eat fish and fruit (and thus in its habits and habitats it may have been less conspicuous than other of its Jamaican congeners), it seems highly unlikely that the species still persists in Jamaica. I know of only three specimens in American collections; I have examined these lizards in the collection of the Museum of Zoology at the University of Michigan and the Museum



of Comparative Zoology at Harvard University through the courtesy of Charles F. Walker and Ernest E. Williams. If for no other reason, *D. occiduus* is the most distinctive of the Antillean *Diploglossus* because of its very great size.

When I reviewed the galliwasps of the Hispaniolan *costatus* complex, I examined a specimen in the United States National Museum from Rivière Bar (= Rivière des Barres) in northern Haiti; this specimen was collected by W. L. Abbott in 1917 and had been assigned by Cochran (1941:250) to her all-inclusive "*Celestus costatus*." In turn, in my review of this complex, I consider the lizard as *D. stenurus rugosus* (1964: 17) and commented upon its very large size (snout-vent length 230 mm) which far exceeded that of any other specimen of *D. stenurus* studied. The lizard is badly crushed about the head, and details of head scutellation (aside from the position of the angular subocular on both sides) cannot be determined. I had suspected that possibly this lizard represented still another distinct taxon from northern Haiti, a taxon related to the *costatus* complex (which includes *costatus*, *stenurus* and *curtissi*), but the condition of the single specimen, its faded pattern due to length of time in preservative, and the fact that there was but one animal made its description an improvident course.

Through the efforts of C. Rhea Warren, herpetological collections were made on Ile de la Tortue off the northern Haitian coast in 1968. The herpetofauna of this island has been very poorly known, and through the efforts of Mr. Warren and local natives, excellent collections including several unexpected forms have now been collected there. Among the lizards secured are three species of *Diploglossus*: *costatus*, *curtissi*, and two specimens of the giant form previously known from Rivière des Barres. The absence of *D. stenurus* or immature representatives of the giant species is remarkable, although neither *costatus* nor *curtissi* is apparently common in the vicinity of Palmiste, whence the recent collections have come. It is moreover remarkable that the Rivière des Barres lies on the Haitian coast immediately opposite Ile de la Tortue and just to the east of the town of St. Louis du Nord. The entire northern Haitian coast has been poorly represented by *D. stenurus*

(despite many collections from Cap-Haïtien and its vicinity in recent years); this species has been reported from Bombardopolis on the Presqu'île du Nord Ouest on the west, and near Limbé and near Limonade to the east of the Rivière des Barres (one specimen from each of these three localities; Schwartz, 1964:18). However, additional material more recently collected by Richard Thomas shows that *D. stenurus* is fairly common near Limbé, and in the vicinity of Limonade, and inland from Anse à Margot, all settlements on the northern Haitian versant. Thomas's material is both crucial and critical as far as comparison of *D. stenurus* and the new species is concerned.

Examination of Thomas's excellent series of 26 *D. stenurus* from these localities shows that there is nothing distinctive in size as far as they are concerned. The largest specimen (Albert Schwartz Field Series [ASFS] V9957) is a male with a snout-vent length of 138 mm; this measurement lies within the known extremes of male *D. stenurus* (maximum size 172 mm snout-vent length in *D. s. stenurus*, the largest of the four subspecies). Patterned *D. stenurus* from northern Haiti have the back covered with closely appressed dark brown and fragmented herringbones; the largest *D. stenurus* from this region (ASFS V9957) shows a dissolution of this pattern to one of dark longitudinal lines, the lines lying on the center of each dorsal scale row. If such a pattern is the result of ontogenetic change in these northern Haitian *D. stenurus*, then the dorsal patterns of the very large specimens is characteristic only of them and not of merely large-sized *D. stenurus*.

This pattern achieves some importance, since there are no meristic scale characters which separate the large species from its smaller relatives. This, however, is not surprising; examination of the data from the *costatus* complex (Schwartz, 1964) shows that various scale counts have little or no significance in separating the species *stenurus*, *costatus* and *curtissi* from each other. For instance, ventrals scales between the mental and the vent range from 81 to 105 in *stenurus*, 77 to 100 in *costatus*, and 80 to 102 in *curtissi*; similarly, scales around the body at midbody are 37 to 45 in *stenurus*, 35 to 44 in *costatus*, and 33 to 42 in *curtissi*. More important is keeling of the

dorsal body and caudal scales, and striation of the ventral scales. Of the three well-known species, *stenurus* has keeled dorsal body and caudal scales and smooth ventrals, whereas both *costatus* and *curtissi* have smooth dorsal body and caudal scales and striate ventrals. The new northern Haitian species has very strongly keeled dorsal body and caudal scales, and striate ventral scales, and thus differs in this combination of characters from all other members of its complex in Hispaniola. Differences between these Haitian specimens and the Jamaican *D. occiduus* will be pointed out below; despite the fact of large size in both *occiduus* and the new species, the former is much the larger and bulkier lizard, and there is no close resemblance or relationship between the two species.

Aside from examining specimens of other Hispaniolan species in the ASFS, I have borrowed two specimens of *D. occiduus* (UMMZ 53249, 53251) from the University of Michigan, and one from the Museum of Comparative Zoology (MCZ 74090); I acknowledge the cooperation of Charles F. Walker and Ernest E. Williams for the loans of such valuable material. C. Rhea Warren was instrumental in the collection of and my receipt of one individual of the new form. The second Warren lizard had been deposited in the living herpetological collection of the New York Zoological Society, under the curatorship of F. Wayne King. Dr. King very generously allowed me to preserve this remarkable lizard, and it has been placed in the collection of the American Museum of Natural History (AMNH). I have borrowed the Abbott specimen in the United States National Museum (USNM) through the cooperation of James A. Peters and George R. Zug. Mr. Warren's travels in Haiti were greatly facilitated by M. Ramah Théodore, Directeur Général Adjoint de l'Office Nationale du Tourisme et de Propagande. I am especially grateful to Dr. King for allowing me to preserve a lizard which might otherwise have afforded an unusual display. In honor of Mr. Warren, who was instrumental in securing two of the three known specimens, I name the new species

***Diploglossus warreni* new species**

Holotype: AMNH 103215, an adult female, from Palmiste, Ile de la

Tortue, Département du Nord Ouest, Haiti, taken 27 January 1968 by natives for C. R. Warren. Original number ASFS V15082.

Paratypes: USNM 59435, an adult male, from Rivière des Barres, Dépt. du Nord Ouest, Haiti, 21 February 1917, W. L. Abbott; ASFS V15071, same locality as holotype, November 1968, natives for C. R. Warren.

Definition: A species of *Diploglossus* of the Hispaniolan *costatus* complex which differs from other members of that complex (*costatus*, *stenurus*, *curtissi*) in much larger size (male *warreni* to 230 mm snout-vent length; female *warreni* to 227 mm snout-vent length; largest male and female of three other species those of *stenurus* with maximally sized male 172 mm, female 143 mm), low number of ventral scales between mental and vent (84 to 92 in *warreni*, 77 to 106 in other members of the complex combined), dorsal trunk scales striate and with a strong median keel, dorsal caudal scales likewise striate and strongly keeled, ventral scales finely striate; dorsal pattern consisting of a series of medium dark grayish chevrons, more or less confluent medially (especially anteriorly) and extending the full length of the unregenerated portion of the tail, on a pale tan to yellow-tan ground, sides very pale gray, flecked with dark brown and with remnants of vertical bars corresponding to lateral ends of dorsal chevrons, postocular dark mask obsolete and only very faintly indicated, iris brown, and venter immaculate cream to very pale orange-tan.

Distribution: Known only from Ile de la Tortue and from the adjacent Haitian mainland in the Département du Nord Ouest.

Description of holotype: An adult female with snout-vent length of 218 mm, tail (regenerated for distal half) 111 mm; scales between mental and vent 92, scales around body at midbody 37, 11 chin shields, angular subocular between supralabials 6 and 7 on both sides; fourth toe lamellae 15, arm length 32 mm, head width 27.0 mm, head length 34.1 mm. Color in life dorsally yellow-tan (Pl. 14 K 6; all color designations from Maerz and Paul, 1950) with a series of about 16 widely opened darker brown (Pl. 15 C 9) chevrons from the neck to the groin, the anterior neck with a vague pair of broad paramedian lines, which extend to just above the forelimb insertion and are concolor with the dorsal chevrons and obviously a part of that pattern sequence; about 6 chevrons between the groin and the regenerated portion of the tail; head scales tan, immaculate; sides pale gray, flecked with brown especially in the regions where a very vague series of vertical tannish lateral bars corresponds to the position of the lateral ends of the dorsal chevrons; both fore- and hindlimbs yellowish tan with a brown reticulum which isolates islands of the paler ground color; postocular mask obsolete, represented only by a vague dusky area from the eye onto the temple; upper labials and chin pale gray, with some brownish suture-following pigment on the chin; venter pale orange-tan (Pl. 12 C 5), immaculate except for some dark gray blotches on the free edge of the anal flap; subcaudal scales concolor with those of venter; iris brown.

Variation: USNM 59435, an adult male, has the following measure-

ments (in millimeters) and counts: snout-vent length 230, tail about 70, distal third regenerated; scales between mental and vent 84, scales around body at midbody 37, 9 chin shields, angular subocular between supralabials 6 and 7 on both sides; fourth toe lamellae 18, arm length 48; head too badly damaged for measurements but conspicuously swollen and enlarged in masseteric region; specimen badly discolored but dorsal crossbars or chevrons still barely visible and uncountable; venter completely immaculate. ASFS V15071, an adult female, has the following measurements and counts: snout-vent length 227, tail about 175, distal third regenerated; scales between mental and vent 88, scales around body at midbody 37, 11 chin shields, angular subocular between supralabials 7 and 8 on left side, between 6 and 7 on right side; fourth toe lamellae 15, arm length 50, head width 32.4, head length 40.7. Color in life medium brown above with a series of grayish brown chevronate elements, at times broken middorsally to give a middorsal reticulum, extending from nape onto unregenerated portion of the tail, about 18 chevrons between the nape and the groin, about 14 chevrons between the groin and the regenerated portion of the tail; head scales medium brown margined with dark brown along their posterior borders; sides gray, irregularly flecked with brown; limbs slightly darker gray, the forelimbs with an irregular brownish reticulum, the hindlimbs with each scale outlined with dark brown; postocular mask obsolete, represented by an area of irregularly darkened scales in the temporal region; upper labials grayish, margined with dark brown; venter cream to white, immaculate except for very pale gray sutures on the sublabials and throat scales, and irregular black blotches on the free edge of the anal flap; subcaudal scales with a pattern of dark brown lines radiating from the base of each scale to give a characteristic dark fan-shaped pattern.

Comparisons: *D. warreni* requires comparison only with *D. stenurus*, apparently its closest relative on Hispaniola, and with *D. occiduus* in Jamaica, the only Antillean species which is as large as or larger than *D. warreni*. Comparison with *occiduus*¹ is the more easily made (but I

¹ Dr. Walker advised me that the smaller of the two UMMZ *D. occiduus* (UMMZ 53251) has been considered a representative of *Diploglossus hewardi*. The lizard may well be *hewardi*, but I consider it *occiduus*. Comparison of this specimen with a series of 22 *hewardi* suggests the following differences between them and the problematical UMMZ specimen. Half-jaw counts of position of the angular subocular in *hewardi* are regularly 6/7 or 7/8, with the latter category having the higher incidence (30). The UMMZ lizard has this scale between supralabials 8 and 9 unilaterally, apparently an *occiduus* character. The two giant *occiduus* have striate but unkeeled dorsal scales, weakly striate caudals, and smooth ventrals, whereas the series of *hewardi* has striate and strongly keeled dorsals, caudals striate or striate to very weakly keeled, and ventrals smooth to weakly striate. The absence of keels on the dorsals of UMMZ 53251 suggests that this specimen is an *occiduus*. There seem to be no differences in the head scutellation (other than the position of the angular subocular) useful in differentiating these two taxa; the ventral count of 121 in the problematical specimen is slightly higher than the 107

doubt that these two species are at all closely related); ventral scales in *occiduus* vary between 107 and 121, midbody scales are 49 and 50, the angular subocular lies between supralabials 8 and 9 (unilaterally in UMMZ 53251 and MCZ 74090), fourth toe lamellae vary between 16 and 23, the dorsal body and caudal scales are striate but not keeled, and the ventrals are smooth. UMMZ 53249, an adult male, has a snout-vent length of 305, head length 66.8, head width 55.5, and arm length of 69. Similar measurements on MCZ 74090, a female, are 256, 52.9, 40.5 and 57; both are very much larger and bulkier lizards than *D. warreni*. All specimens of *D. occiduus* are presently bleached, so that no data are available from them on color or pattern. Boulenger (1885:290) stated that *D. occiduus* was "Brownish above, with dark brown spots or cross bands." Structurally, *occiduus* differs most strikingly from *warreni* in that the former has striate dorsal body and caudal scales and smooth ventrals, whereas *warreni* has strongly keeled dorsal body and caudal scales and finely striate ventrals. The higher number of ventral scales and midbody scales in *occiduus* likewise separates the two species; the position of the angular subocular between supralabials 8 and 9 in *occiduus* differs from its position between 6 and 7 in *warreni*.

D. warreni differs from *D. stenurus* in several features. First, the strongly keeled dorsal body scales and the very strongly carinate caudal scales differ from the keeled condition in *stenurus*. Although these scales are keeled in *stenurus*, even in large adult individuals of the latter species the keels are much lower. This is most especially shown by the caudals in *warreni*; these scales have such high keels that the tail appears angulate on gross inspection. The ventral scales of *warreni* are finely striate, whereas these scales are smooth in *stenurus*. Secondly, the dorsal pattern, although reminiscent of that of *stenurus*, is distinctive. *D. stenurus*, *D. costatus* and *D. warreni* have a community of dorsal pattern elements; the pattern is composed basically of chevrons or (when these are widely opened) crossbars which extend from the nape to at least the base of the tail. In *costatus* the chevrons are fine and narrow, giving a herringbone pattern, whereas in *stenurus* the chevrons are fragmented and are made up of more or less isolated dark squares or rectangles arranged in a chevronate pattern (see Schwartz, 1964:15, figs. 1-4), which, however, lacks the clarity and diagrammatic distinctness of the *costatus* pattern. Both these species likewise have, in most subspecies, a pair of anterior paramedian nuchal lines, much better delineated in *D. stenurus* (especially in *D. s. alloekides* Schwartz)

and 118 counts for the undisputed *occiduus* and within the range of that count in *hewardi* (113-135), but then very little is known about the variation of this character in *occiduus*. Midbody counts in the two large *occiduus* are 49 and 49-59 in *hewardi*; the smaller *occiduus* has a count of 50. I do not consider, nor did Couzens (*loc. cit.*), that *occiduus* and *hewardi* are conspecific. But immature *occiduus* may be difficult to separate from *hewardi* except for modal differences, and the same may well be true of juvenile *warreni* and *stenurus*.

than in *D. costatus*. The dorsal pattern of *D. warreni* likewise is basically chevronate, but the chevrons, since they are widely opened, are almost crossbars. Additionally, these bars are broad and entire (not fragmented as in *stenurus*) and may be joined medially at their apices in an irregular fashion. There is no indication of paramedian nuchal lines, although the holotype has dark paramedian blotches on the neck. Thus, although the species *warreni*, *stenurus* and *costatus* are all basically chevronate, the degree and quality of the dorsal markings varies with the species. Thirdly, *D. warreni* is by far the largest member of the *costatus* complex in Hispaniola. Maximally sized *stenurus* (males first, females second in each case) are 172 and 143, maximally sized *costatus* measure 127 and 116, and maximally sized *curtissi* 86 and 82. The male *warreni* has a snout-vent length of 230, the larger female 227; in these measurements *warreni* ranks second only to *occiduus* in the Antilles.

Scale count differences between *warreni* and *stenurus* are difficult to assess, since there are counts available on only three *warreni* in contrast to those from several hundred *stenurus*. However, the *warreni* counts of ventral and midbody scales fall toward the lower extremes of these counts in *D. stenurus*, and in the case of midbody scales, the counts of *warreni* (33-37) lie just below the counts for *stenurus* (37-45). Overlap of counts is of little significance in this group of galliwaspes, since even such strikingly different species of *stenurus* and *curtissi* have almost identical extremes in ventral and midbody counts. It would be extremely pleasant if *warreni* differed quantitatively from *stenurus* in some meristic character, but such is not the case, at least in those counts which I have heretofore employed in differentiating members of this Hispaniolan complex.

One other characteristic separates *warreni* from *stenurus*. In the former, the subcaudal scales are very large and almost fanlike in aspect; this resemblance is further enhanced by the dark brown lines of pigment which may radiate from the base of each scale. Such radiations do not occur in *stenurus* and the ventral caudal scales are relatively (as well as actually) much smaller. Thus the subcaudals in *warreni* are much larger than are those in *stenurus*. Finally, the distinctly angulate appearance of the tail, due to the high median keels on the dorsal caudal scales, does not occur in *stenurus*; in the latter species, although the dorsal caudals are keeled, the keels are not so high and do not impart an angulate or longitudinally keeled aspect to the upper side of the tail.

Remarks: Despite the fact that I regard *D. warreni* as a species distinct from *D. stenurus*, nevertheless, the very fact that I previously considered the USNM paratype of *D. warreni* as a *stenurus* suggests the similarity between these two species. The age and condition of the USNM specimen, as pointed out above, prevented my assessment of its characteristics. Still, *D. stenurus* is unknown from Ile de la Tortue and from the northern Haitian coast in the immediate region of St. Louis du Nord-Rivière des Barres. Thus, there is a possibility that the speci-

mens I consider *D. warreni* are either 1) merely very large *D. stenurus* or 2) represent a local very large subspecies of *D. stenurus*. Neither of these possibilities can be absolutely refuted. But the facts that large *stenurus* from adjacent areas show no approach to the dorsal pattern of *warreni* and that, of hundreds of *stenurus* studied from throughout Hispaniola, none begins to approach the very large size of *warreni* suggests that these lizards are related to, but not conspecific with, *D. stenurus*. The structural characteristics of *D. warreni*, in comparison with those of *D. stenurus*, of course also militate against the conspecificity of the two taxa. The compact known geographic distribution of *D. warreni* also suggests that this population is distinctive from *D. stenurus*.

There is another inductive line of reasoning for specific status of *D. warreni*. Etheridge (1965:99-100), while discussing the fossil lizards from a cave at Cerro de San Francisco near Bánica in San Rafael Province, República Dominicana, distinguished between two size-classes of fossil *Diploglossus* found in this cave: one group with a presumed snout-vent length of 120 to 130 mm (*costatus*) and another group with a presumed snout-vent length of about 210 to 250 mm ("*stenurus*"). Dr. Etheridge made the latter assignment at the time because of my as yet unpublished data on the maximum size of *D. stenurus*; this maximum size (230 mm) was of course based upon the USNM paratype of *D. warreni*. The presence in these deposits of the two size groups suggests that there were indeed two species present, one of which (*warreni*) is much the larger. *D. warreni* is not known today from the Bánica area.

The presence of apparent *warreni* fossils from the interior of the República Dominicana, and the known occurrence today of this species only along the northern Haitian littoral and on Ile de la Tortue suggest that the species was once more widely distributed, and that it persists today mainly along the northern Haitian coast and on Tortue. The absence of *D. stenurus* on Tortue is especially puzzling, but considering the apparent rarity of any species of *Diploglossus* on that island, it is possible that *stenurus* occurs there. Another possibility is that large *stenurus* is incapable of competing with even larger *warreni*, and that *stenurus* has not been able to establish itself on Tortue where *warreni* is a long-established species. If the Bánica fossils are correctly interpreted as *warreni*, the previously widespread distribution of that species and its present apparently circumscribed (and partially insular) range seems clearly to indicate that *warreni* is a relict species, persisting in small numbers in northern Haiti and on Ile de la Tortue.

Mr. Warren advises me that the vicinity of Palmiste is mesic, and that the region immediately about the Rivière des Barres is likewise mesic, sufficiently so to allow the growing of bananas and coffee very near the coast. Farther to the west at Port-de-Paix, the countryside is scrub-grown and arid. Of the lizards reported by Etheridge from the pre-Columbian strata at Cerro de San Francisco, none is a confirmed

inhabitant of xeric areas (although *A. chrysolaema* is a xerophile in some parts of its range); several species (*Anolis ricordi*, *Anolis cybotes*, *Anolis chlorocyaneus*, *Leiocephalus personatus*, *Ameiva taeniura*, *Diploglossus costatus*) are inhabitants of cool, shaded, and relatively moist areas. Considering the habitat preference (so far as it can be known from the few specimens available) of living *D. warreni*, it seems possible that the region about Cerro de San Francisco was formerly mesic and forested.

In summary, it seems probable that *D. warreni* was once more widely distributed on Hispaniola, but that (because of stringent ecological requirements?) it has disappeared from much of its former range and persists only on the mesic northern Haitian coast and on Ile de la Tortue. Perhaps the presence of *D. warreni* on Tortue has prevented the success there of its largest congeneric relative, *D. stenurus*.

Underwood (1959:11) suggested that since the Jamaican *microblepharis* was related to Cuban-Puerto Rican *delasagra-pleii* it was most likely that this group of species, on the basis of geographical distribution of its known members, must have a Hispaniolan representative. I agree, but *D. warreni* is not that as yet unknown member. Rather, the relationships of *warreni* are clearly with the *stenurus-costatus-curtissi* series on Hispaniola, *warreni* representing the culmination of size in this complex. Similarly, *occiduus* in Jamaica seems to represent the culmination of a Jamaican series (*crusculus-hewardi-barbouri*) with *crusculus* the smallest member in the series. In both cases the series progresses from small short-limbed species to very large long-limbed species. As in the *costatus* complex, the basic Jamaican dorsal pattern is a series of fine and narrow, closely appressed chevrons, giving a herringbone pattern. I am less sure of this sequential series in Jamaica than in the *costatus* series in Hispaniola; for one reason, Underwood (*op. cit.*:13, table) indicated that *occiduus* is the only member with many scale organs on the dorsal scales whereas all other Jamaican galliwaspas have the scale organs present on the dorsal scales but apparently they are not so numerous as in *occiduus*. If many scale organs is a more primitive condition than few-to-no scale organs, then on the basis of this character, *occiduus* would seem to be the primitive member of the Jamaican series, and the remainder of the Jamaican species are derived forms—a situation which, on the basis of size, seems unlikely. Thus, the series of Jamaican galliwaspas does not demonstrate the clearly sequential evolutionary series that the Hispaniolan *costatus* group members show.

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